Overview on research activities and important rice residue issues in Malaysia

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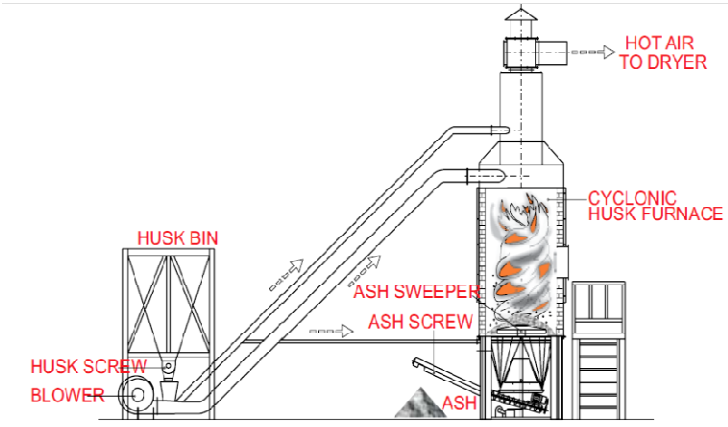
what we are doing

- Emission monitoring studies of a rice mill
- Characterization of the Rice Husk Char from the rice Mill
- Composting trials using the Rice husk Char

Emission monitoring studies of Rice mill

- Bernas Rice mill , Klentan, Malaysia
- Cyclonic furnace was being used to produce thermal energy and rice husk char.
- Thermal energy being used to run dryers to dry paddy.

Furnace



Parameters determined

- Proximate composition of rice husk and char
- Empirical formula of rice husk
- Mass and energy balance calculations

using estimated and measured values of gas monitoring

- Emission factors
- Rice husk feed input and char output

Ultimate and proximate analysis composition of rice husk

	C*	H*	O*	N*	Ash [% wt d.b.]	Moisture (%)	Reference
1	48.45	6.16	44.62	0.55	19.54	10.3	Kouprianov and Permchart (2004)
2	48.73	5.91	44.64	0.65	20.5	10.0	Ghosh et al (2006)
3	48.9	6.2	44.1	0.8	17.9	Na	Wannapeera et al (2008)
4	47.2	6.37	45.6	0.80	8.93	9.37	Guerrero et al. (2008)
5	50.8	6.66	41.8	0.78	23.5	Na	Raveendran et al. (1995)
Average %	48.8	6.3	44.2	0.7	18.1	9.9	
Std Dev (%)	1.3	0.3	1.4	0.1	5.5	0.5	

Empirical formula and equation

- The empirical formula determined was

$CH_{1.5}O_{0.7}N_{0.01}$ Or $C_{100}H_{150}O_{70}N$

- The balnced equation for complete combustion was established
- $CH_{1.5}O_{0.7} + 1.025(O_2 + 3.76\ N_2) \rightarrow CO_2 + 0.75H_2O + 1.025(3.76N_2)$
- Equation for char production of 50kg/hr(after considering moisture contents,ash,unburnt rice husk) were established and flue gas quantity was calculated
- 3-24.7g $CH_{1.5}O_{0.7}$ + 140.712 g_{air} → 165.412 $g_{flue\ gas}$

Emission factors

- From developed equations, 0.93kg C/kg of rice husk was estimated as emissions.
- Emission factors calculated from pressure measurements for 25 min and 55 min were 1.24 kg C / kg and 1.538 kg C/Kg of rice respectively .
- Values are 16 % and 56% higher than calculated may be due to fluctuations in feed stock rate and other parameters.
- So recommended time of sampling should be at least 4 hours.

Rice husk Char

- Produced in cyclonic furnace
- Seong Heng Rice Mill Kedah, Malaysia

- 550-600 degree Celsius

Rice husk Char characterization

- Particle size distribution
- Moisture content
- Ash content
- CHNS/O analysis
- Cation exchange capacity
- BET surface area
- Micropores (SEM)

Findings

- RHC was highly alkaline pH=8.9
- C contents 16% dry basis
- CEC = 17 cmol/kg soil
- BET surface area = 401 m^2/g
- Methylene blue adsorption capacity = 38.8 mg/g as compared to rice husk which has 28mg/g .

Char from cyclonic furnace and other processes

Characteristics	Cyclonic combustion 550-600˚C	*Gasification 900-1100˚C	**Rapid pyrolysis 850-1200˚C
pH	8.9	9.2	-
CEC (cmol/kg soil)	17	45	-
BET surface Area (m^2 / g)	401	-	56.9
Total Carbon (%)	16	35	38.5

Proximate analysis comparison

Characteristics	RHC (local) 550°-600°C	*Pyrolsed at 580°C	**Pyrolsed at (550°C)
Proximate analysis (wt. %)			
Moisture	7.1±1.3		
Ash	78.8 ±0.8	36.1	54.0
Ultimate analysis (wt. % d.a.f.)			
C	77.9±5.9	80.6	68.4
H	3.5± 0.1	3.3	4.0
N		0.72	1.4
S	0.30± 0.05	0.03	0.06
O	18.3± 9.4	15.3	26.1
Atomic ratio			
H/C	0.534	0.490	0.700
O/C	0.173	0.143	0.286

MB adsorption capacities

Adsorbent	MB adsorption capacity (mg/g)
RHC (this study)	38.8
Rice husk	28.0
Rice Husk Ash (white)	22.7
Rice husk activated carbon	344
Wood charcoal	62.7
Coconut shell activated carbon	127

Composting process

- RHC was added to chicken dung(50%), rice bran, fish meal, oil pal bunch ash and rock phosphate.
- Treatment 1= with out Rice Husk Char
- Treatment2= 4% RHC
- Treatment 3= 6% RHC

continued

- Samples were analysed after 0,5,10,25,35 and 50 days
- Daily temperature monitoring, CO_2 flux, Moisture contents, total carbon and nitrogen and microbial population was measured.
- High C/N ratio found in T_2 and T_3
- The N contents generally showed an increasing pattern from 0 to 50 days in all compost piles.
- The nitrogen contents in treatment 2 and 3 were found significantly high during the thermophilic phase as compared to treatment 1.

Findings

- An increase in microbial activity is observed in T-2 and T-3 treatments
- High water holding capacity of RHC reduced the moisture loss and sustained the water contents in compost so an expected reduction in nutrient leaching may be observed.